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Pesticide Fact Sheet Number 37: Chlorpyrifos

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This document contains up-to-date chemical information, including a summary of the Agency's regulatory position and rationale, on a specific pesticide or group of pesticides. A Fact Sheet is issued after one of the following actions has occurred.

1. Issuance or reissuance of a registration standard,
2. Issuance of each special review document,
3. Registration of a significantly changed use pattern,
4. Registration of a new chemical, or
5. An immediate need for information to resolve controversial issues relating to a specific chemical or use pattern.

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Washington, DC 20460

EPA

Pesticide Fact Sheet

Name of Chemical: CHLORPYRIFOS
Reason for Issuance:
Date Issued: September 30, 1984
Fact Sheet Number: 37

1. DESCRIPTION OF CHEMICAL

Generic Name: 0,0-diethyl 0-(3,5,6-trichloro-2-pyridyl) phosphorothioate

Common Name: Chlorpyrifos

Trade Name: Dursban for household products, Lorsban for agricultural products

EPA Shaughnessy Code: 059101

Chemical Abstracts Service (CAS) Number: 2921-88-2

Year of Initial Registration: 1965

Pesticide Type: Insecticide

Chemical Family: Organophosphate

U.S. and Foreign Producers: Dow Chemical U.S.A.
Makhteshim-Beer Shiva
All India Medical Corp
Planters Products, Inc.

2. USE PATTERNS AND FORMULATIONS

Application Sites: Grain crops, nut crops, bananas, cole crops, citrus, pome and strawberry fruits, forage, field and vegetable crops, lawns and ornamental plants, poultry, beef cattle, sheep and dogs, livestock premise treatment, domestic dwellings, terrestrial structures, and direct application to stagnant water etc.

Types of Formulations: Baits, dusts, granules, wettable powders, flowables, impregnated plastics and pressurized liquids.

Types of Methods of Application: Ground and aerial, sprays and dust applications

Application Rates: Range from 0.5 lbs. a.i./A to 3 lbs. a.i./A and crack and crevice treatment to broadcast treatment for indoor uses.

Usual Carriers: Synthetic clays, talc, various solvents

3. SCIENCE FINDINGS

Summary Science Statement

Chlorpyrifos has moderate mammalian toxicity. It is not considered to be oncogenic, mutagenic or teratogenic. However, the oncogenicity and mutagenicity studies used to draw these conclusions are not up to current Agency standards. Additional information from these studies is required.

The Agency is imposing a 24-hour reentry restriction for crop uses until appropriate reentry studies are submitted and evaluated and a decision is reached whether a different time interval is more appropriate. The 24-hour interval also coincides with the requirements of California.

Data are insufficient to fully assess the environmental fate of chlorpyrifos. The Agency is requesting necessary data to make this assessment and also to specifically assess whether or not chlorpyrifos has a potential to leach into groundwater. Data are also insufficient to measure human exposure in outdoor and indoor applications.

Chlorpyrifos is extremely toxic to fish, birds and other wildlife. It is highly toxic to honey bees. Use precautions and restrictions are being imposed to reduce potential hazards.

A full tolerance reassessment cannot be completed. The previous ADI (at 94% of the TMRC) was established based on a 2-year rat feeding study. The present ADI (313% of the TMRC) was calculated using a human study. Chronic feeding studies are required as well as metabolism and residue data on numerous commodities.

Chemical Characteristics

Physical State: Crystalline solid

Color: White to tan

Odor: Mild mercaptan

Melting point: 41.5-43.5 °C

Vapor Pressure: 1.87×10^{-5} mm Hg at 20°C

Flash Point: None

Toxicology Characteristics

Acute Oral: 163 mg/kg, Toxicity Category II

Acute Dermal: 1505 mg/kg, Toxicity Category II

Primary Dermal Irritation: No irritation, Toxicity Category III

Primary Eye Irritation: Conjunctival irritation at 24 hours. Cleared at 48 hours. Toxicity Category III

Acute Inhalation: Data gap

Neurotoxicity: Not an acute delayed neurotoxic agent at doses up to 100 mg/kg (highest dose tested).

Oncogenicity: Two studies submitted but neither meet Agency standards. Neither suggest oncogenicity potential.

Teratogenicity: Three studies have been evaluated to determine the teratogenic potential of chlorpyrifos. The Agency has determined that this chemical is not teratogenic at levels up to 25 mg/kg/day.

Reproduction-2 generation: Two studies adequately demonstrate that chlorpyrifos does not produce reproductive effects. No effects were demonstrated at dose levels up to 1.2 mg/kg/day.

Metabolism: The submitted studies suggest that chlorpyrifos is rapidly absorbed and metabolized to 3,5,6-trichloro-2-pyridinal (TCP). The parent compound and metabolite are rapidly excreated in the urine. The submitted studies do not meet Agency standards.

Mutagenicity: Data Gap

Physiological and Biochemical Behavioral Characteristics

Mechanism of Pesticidal Action: An insecticide which is active by contact, ingestion, and vapor action and almost irreversibly causes phosphorylation of the acetylcholinesterase enzyme of tissues, allowing accumulation of acetylchloline at cholinergic neuroeffector junctions (muscarinic effects), and at skeletal muscle myoneural junctions and autonomic ganglia. Poisoning also impairs the central nervous system function.

Symptoms of poisoning include: headache, dizziness, extreme weakness, ataxia, tiny pupils, twitching, tremor, nausea, slow heatbeat, pulmonary edema, and sweating. Continual

absorbtion at intermediate dosages may cause influenza-like illness which includes symptoms like weakness, anorexia, and malaise.

Metabolism and Persistence in Plants and Animals:

The metabolism of chlorpyrifos in plants and animals is not adequately understood. The major metabolite is 3,5,6-trichloro-2-pyridinol (TCP). The Agency does not have adequate data on TCP to determine if this metabolite should continue to be a part of the tolerance expression.

Environmental Characteristics

Available data are insufficient to fully assess the environmental fate of chlorpyrifos. Data gaps exist on all required studies except for aerobic and anaerobic soil studies.

Adsorption and Leaching in Basic Soil Types: The Agency is requesting data to determine if chlorpyrifos will contaminate groundwater.

Microbial Breakdown: Depending on the soil type, microbial metabolism of chlorpyrifos may have a half-life of up to 279 days.

Ecological Characteristics

Avian oral:
Mallard duck--76.6 mg/kg
Ring necked pheasant--17.7 mg/kg

Avian dietary:
Mallard duck--136 ppm
Bobwhite quail--721 ppm

Freshwater Fish:
Coldwater fish (rainbow trout)--3.0 ppm
Warmwater fish (bluegill sunfish)--2.4 ppm

Acute Freshwater Invertebrates:
Daphnia--0.176 ppb

Acute Estuarine and Marine Organisms:
Oyster--0.27 ppm
Grass shrimp--1.5 ppm
Killifish--3.2 ppm

Precautionary language is being required for hazards to birds, fish, and aquatic organisms. Chronic effects to non-target aquatic invertebrate species are not adequately characterized and therefore appropriate studies are required.

Tolerance Assessment

The Agency is unable to complete a full tolerance reassessment because of certain residue chemistry and toxicology data gaps.

Tolerances:

Commodity	Parts Per Million
Alfalfa, green forage	4.0
Alfalfa, hay	15.5
Almonds	0.05
Almonds, hull	0.05
Apples	1.5
Bananas (whole)	0.25
Bananas, pulp with peel removed	0.05
Bean forage	1.0
Beans, lima	0.05
Beans, lima, forage	1
Beans, snap	0.05
Beans, snap, forage	1
Beets, sugar, roots	1.0
Beets, sugar, tops	8.0
Broccoli	2
Brussels sprouts	2
Cabbage	2
Cattle, fat	2.0
Cattle, meat by-products (mbyp)	2.0
Cattle, meat	2.0
Cauliflower	2
Cherries	2.0
Citrus fruits	1.0
Corn, field, grain	0.1
Corn, fresh (inc. sweet corn; kernel plus cob with husk removed)	0.1
Corn, fodder	10.0
Corn, forage	10.0
Cottonseed	0.5
Cranberries	1.0
Cucumbers	0.1
Eggs	0.1
Figs	0.1
Goats, fat	1.0
Goats, mbyp	1.0
Goats, meat	1.0
Grapes	0.5
Hogs, fat	0.5
Hogs, mbyp	0.5
Hogs, meat	0.5
Horses, fat	1.0
Horses, mbyp	1.0

Tolerances (con't)

Commodity	Parts Per Million
Horses, meat	1.0
Milk, fat (reflecting 0.02 ppm in whole milk)	0.5
Mint, hay	1.0
Nectarines	0.05
Onions (dry bulb)	0.5
Pea forage	1.0
Peaches	0.05
Peanuts	0.5
Peanut hulls	15
Pears	0.05
Peppers	1.0
Plums (fresh prunes)	0.05
Poultry, fat (inc turkeys)	0.5
Poultry, mbyp (inc turkeys)	0.5
Poultry, meat (inc turkeys)	0.5
Pumpkins	0.1
Radishes	3
Seed and pod vegetables	0.1
Sheep, fat	1.0
Sheep, mbyp	1.0
Sheep, meat	1.0
Sorghum, fodder	6
Sorghum, forage	1.5
Sorghum, grain	0.75
Soybeans	0.5
Soybeans, forage	8.0
Soybeans, straw	15.0
Strawberries	0.5
Sunflower, seeds	0.25
Sweet potatoes	0.1
Tomatoes	0.5
Turnips (roots)	3
Turnips (greens)	1

Based on established tolerances the theoretical maximum residue contribution (TMRC) for chlorpyrifos residues in the human diet is calculated to be 0.5637 mg/day. The acceptable daily intake (ADI) of chlorpyrifos is 0.003 mg/kg/day. The maximum permissible intake (MPI) is 0.18 mg/day. The percent utilized ADI is 313%. To provide for conformity between U.S. tolerances for chlorpyrifos and tolerances established by the Codex Alimentarius, Canada and Mexico, the expression of the U.S. tolerances for chlorpyrifos would have to exclude the major metabolite TCP, but the Agency is not recommending this now.

U.S. tolerances for most raw agricultural commodities are supported by current residue chemistry data. In some cases however, more data are required.

4. SUMMARY OF REGULATORY POSITION AND RATIONALE

The Agency has determined that it should continue to allow the registration of chlorpyrifos. Adequate studies are available to assess the acute toxicological effects of chlorpyrifos to humans. None of the criteria for unreasonable adverse effects listed in section 162.11(a) of Title 40 of the U.S. Code of Federal Regulations have been met or exceeded. However, because of certain gaps in the data base a full risk assessment of chlorpyrifos cannot be completed.

Also, a full tolerance reassessment cannot be completed because of certain residue chemistry and toxicology data gaps.

The Agency is concerned whether or not the potential total human exposure to chlorpyrifos and its metabolites, from its widespread use and its ADI being exceeded three-fold, poses any unacceptable hazards. To resolve this concern, additional residue, metabolism and exposure data are required, and until it is resolved no significant new tolerances or uses will be granted.

A federal 24-hour reentry interval is established for treated crop areas until reentry data are submitted, as required, and the Agency decides on the most appropriate time interval.

Available data are insufficient to fully assess the environmental fate of chlorpyrifos. The Agency is requesting data to determine if chlorpyrifos will contaminate groundwater.

5. SUMMARY OF MAJOR DATA GAPS

Additional residue data on various processed commodities are being required. Also, additional chronic toxicity, oncogenicity and mutagenicity testing is needed to better define the long term effects of this chemical. Plant, animal and exposure data are required to better qualify and quantify human exposure to residues from dietary and nondietary sources.

Other requirements:

Acute inhalation
General metabolism
Hydrolysis study
Photodegradation studies
Soil metabolism studies
Mobility studies
Dissipation studies

Other Requirements (con't)

Accumulation studies
Fish embryo-larvae study
Large scale field testing
Monitoring for crop runoff
Phytotoxic effects on algae and other aquatic plants
Indoor monitoring

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